NON-PUBLIC?: N
ACCESSION #: 8908230283
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Pilgrim Nuclear Power Station PAGE: 1 of 8

DOCKET NUMBER: 05000293

TITLE: Decreasing Main Condenser Vacuum Resulting in the Initiation of a Manual Scram Due to Procedure Inadequacy
EVENT DATE: 07/18/89 LER #: 89-023-00 REPORT DATE: 08/17/89

OPERATING MODE: N POWER LEVEL: 035

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Douglas W. Ellis, Senior Compliance Engineer TELEPHONE: (508) 747-8160

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On July 18, 1989 at 1038 hours, a manually initiated Reactor Protection System (RPS) scram signal and reactor scram occurred. The scram signal resulted in an automatic sequence of expected designed responses that included a Turbine-Generator trip, automatic opening of two 345 KV switchyard air circuit breakers, and an automatic transfer of station electrical loads.

The direct cause for the scram was the deliberate movement of the reactor mode selector switch (RMSS) from the RUN position while at 35 percent reactor power. This conservative action was taken due to decreasing Main Condenser vacuum. The primary cause for the decreasing vacuum was attributed to an inadequacy in the approved procedure that was being used to reconfigure the steam jet air ejectors of the Main Condenser Gas Removal System.

Corrective actions taken included the following: revision of the procedure to include specific steps for interchanging a steam jet air ejector(s) during operation, and cleaning the saltwater portions of the Circulating Water

System to remove macro-fouling due to marine organisms. The unit was returned to commercial service on July 26, 1989 at 0936 hours.

This event occurred when the Reactor Vessel (RV) pressure was 980 psig and the RV water temperature was 520 degrees Fahrenheit. This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) and this event posed no threat to the public health and safety.

END OF ABSTRACT

On July 18, 1989 at approximately 1038 hours, a manually initiated Reactor Protection System (RPS) scram signal and reactor scram occurred while at 35 percent reactor power.

As expected, the scram signal resulted in an automatic sequence of designed responses that included a Turbine-Generator trip. The Turbine trip included the following responses:

o Automatic closing of the Main Steam System/Turbine Valves (stop valves, control valves, combined intermediate valves), automatic opening of the Turbine Bypass Valves, and a trip of the Turbine lockout relay (286-2).

o Automatic opening of the Generator Field Breaker. The Generator trip was the designed response to the loss of field that resulted from the automatic opening of the field breaker.

o Automatic opening of the 345 KV switchyard air circuit breakers ACB-104 (352-4) and ACB-105 (352-5).

o Automatic transfer of the source of power for the Auxiliary Power Distribution System from the Unit Auxiliary Transformer to the Startup Transformer.

As expected, the RV water level decreased in response to the scram because of shrink (i.e., decrease in the void fraction in the RV water). The RV water level momentarily decreased to approximately zero inches (narrow range level). The decreased RV water level, to less than the low RV water level calibrated setpoint (+12 inches), resulted in the following expected designed responses:

o Automatic actuation of the Reactor Building Isolation Control System (RBIS). The actuation resulted in the automatic closing of the Reactor Building/Secondary Containment System (SCS) supply and exhaust ventilation dampers (Trains 'A' and 'B'), and the automatic start of Trains 'A' and 'B' of the SCS/Standby Gas Treatment System (SGTS).

o Automatic actuation of appropriate portions of the Primary Containment Isolation Control System (PCIS). The actuation resulted in the following responses:

o Automatic closing of the inboard and outboard Primary Containment System (PCS)/Reactor Water Sample isolation valves (AO-220-44 and -45).

o Automatic closing of the inboard and outboard PCS Group 2 (two)/Sample System isolation valves that were open.

o The PCS Group 3 (three)/Residual Heat Removal System isolation valves, in the closed position, remained closed.

o Automatic closing of the inboard and outboard PCS Group 6 (six)/Reactor Water Cleanup (RWCU) System isolation valves and a temporary interruption in RWCU System operation.

Initial Control Room operator response was orderly and included the following activities. The process of verifying the insertion of the control rods began in accordance with procedure 2.1.6, "Reactor Scram", and Emergency Operating Procedure (EOP) -01, "RPV Control", was initiated at approximately 1039 hours.

At approximately 1045 hours, the RPS circuitry was reset in accordance with procedure (2.1.6), and procedure 2.1.5 section B, "Operation After Reactor Scram with MSIVs Open", was initiated. The EOP-01 was terminated at 1048 hours after verifying the control rods were inserted. The verification included Panel C-905 indication' positioning the RMSS to the REFUEL position, and process computer printouts. At 1050 hours, procedure 2.1.7, "RPV Temperature and Pressure Check List", was initiated. At approximately 1052 hours, the PCIS circuitry was reset and the RWCU System was returned to service at approximately 1054 hours. At 1100 hours, the RBIS circuitry was reset. The Reactor Building/SCS supply and exhaust ventilation dampers were reopened and the SGTS was returned to normal standby service. At 1115 hours, the Turbine lockout relay (286-2) was reset and ACBs 104 and 105 were reclosed.

Failure and Malfunction Report 89-273 was written to document the event. An information call regarding the event was made to the NRC Operations Center on July 18, 1989 at 1108 hours. A post trip review of the event was conducted in accordance with procedure 1.3.37, "Post Trip Reviews". Subsequent review of the event determined that a notification call was required in accordance with 10 CFR 50.72(b)(2)(ii) and the NRC Operations Center was notified on July 18, 1989 at 1748 hours.

This event occurred during power operation. The Reactor Vessel (RV) pressure was approximately 980 psig and the RV water temperature at approximately,520 degrees Fahrenheit.

BACKGROUND

Prior to the event, steady state operating conditions existed and included the following. The reactor power level was at 50 percent. The RV water level was +29 inches and was being controlled automatically in the three element control mode. The Recirculation System pumps were being controlled in the local manual control mode. The Condensate System was operating with two of the system's three pumps in service. The Main Condenser vacuum, normally at approximately 29 inches of mercury, was at 28.5 inches of mercury.

The Main Condenser hotwell temperature was approximately 90 degrees Fahrenheit. Both Circulating Water System pumps were in service providing saltwater cooling to the Main Condenser.

The Main Condenser Gas Removal (MCGR) System functions to remove air, non-condensible gasses and water vapor from the Main Condenser. The MCGR System consists of the Steam Jet Air Ejector (SJAE) and Mechanical Vacuum Pump (MVP) subsystems. The MVP subsystem is operated during startups and shutdowns, and the SJAE subsystem is operated when the Main Condenser vacuum is approximately 22 inches of mercury or greater. The SJAE subsystem consists of 4 (four) primary air ejectors ('A', 'B', 'C', 'D') and 2 (two) secondary air ejectors ('A' and 'B'). Normally, the SJAE subsystem is operated with two primary air ejectors and one secondary air ejector in service. The two primary air ejectors, one for each of the two Main Condenser shells, remove the air/gas/vapor mixture from the Main Condenser. The mixture is discharged to the Intercondenser and the resulting condensate is directed to the Main Condenser hotwell. The secondary air ejector removes the non-condensible gasses and water vapor from the Intercondenser and discharges the mixture to the Aftercondenser. The resulting condensate is directed to the Main Condenser hotwell. The remaining non-condensible gasses and entrained water vapor are discharged from the Aftercondenser for subsequent processing in the Offgas (and Augmented Offgas) System. The Intercondenser and Aftercondenser are each cooled by condensate derived from the Main Condenser hotwell via the Condensate System pumps.

On July 18, 1989 the Chief Operating Engineer (COE) directed the SJAE subsystem to be reconfigured from Train 'B' operation to Train 'A' operation. This action was to be taken because previous testing indicated that the SJAE Train 'A' might be more efficient for the removal of suspected air in-leakage to the Main Condenser. A pre-evolution briefing was conducted in accordance with procedure (1.3.34, "Conduct of Operations"). The briefing was conducted by the shift Nuclear Operating Supervisor (NOS), and was attended by appropriate utility operators (licensed and non-licensed) who would be involved with the evolution. The briefing included the procedure (2.2.93 - Rev. 15 "Main Condenser Vacuum System" section 7.3) to be used, the related system drawing (M-210), and possible system responses that could result from the evolution.

At approximately 1000 hours, the (utility licensed) shift NOS and two utility non-licensed operators began to put the SJAE Train 'A' (primary air ejectors 'A' and 'D' and secondary air ejector 'A') into service. This evolution was in accordance with procedure (2.2.93) and was directed by the NOS. At approximately 1015 hours, the NOS notified the shift Nuclear Watch Engineer (NWE) that the SJAE Train 'A' air ejectors were in service and that the Train 'B' air ejectors ('B', 'C', 'B') were about to be removed from service. While the Train 'A' air ejectors were being put into service, the Main Condenser vacuum, being monitored by a licensed operator in the Control Room, began to decrease. Concurrently, the Control Room Panel C-905R alarm, "Offgas High Flow", occurred intermittently and the Offgas System flowrate downstream of the Aftercondenser increased rapidly in a fluctuating manner during the evolution.

Because of the decreasing vacuum, then at 27.9 inches of mercury, the shift NWE directed a reduction in Reactor Vessel recirculation flow to reduce the reactor power level and improve the Main Condenser vacuum. This action was taken in accordance with procedure 2.4.36, "Decreasing Condenser Vacuum." Meanwhile, the Train 'B' air ejectors had been removed from service. While the Train 'B' air ejectors were being removed from service, the Main Condenser vacuum continued to decrease and the Offgas System flowrate downstream of the Aftercondenser decreased rounds per hour) in a fluctuating manner.

At approximately 1020 hours, the shift NWE directed the NOS to verify that the Train 'A' air ejector lineup was correct. After the lineup was verified to be correct, the shift NWE then directed the NOS to return the SJAE subsystem to the original configuration (i.e., Train 'B' air ejectors in service and Train 'A' air ejectors not in service). The course of action was taken because the Main Condenser vacuum, then at approximately 27.0 inches of mercury, continued to decrease and because the Offgas System flowrate downstream of the Aftercondenser remained at approximately zero. Meanwhile, as the Reactor Vessel recirculation flow was gradually reduced, the shift NWE directed that the appropriate control rods be sequentially inserted to further reduce the reactor power level. This action was taken to improve Main Condenser vacuum and is in accordance with procedure (2.4.36).

The Train 'B' air ejectors were then put into service in accordance with procedure (2.2.93). During this evolution, the Main Condenser vacuum continued to decrease to approximately 26.5 inches of mercury and the Offgas System flow increased rapidly in a fluctuating manner. While the Train 'A' air ejectors were being removed from service in accordance with procedure (2.2.93), the Main Condenser vacuum continued to decrease and the Offgas System flow decreased to approximately zero in a fluctuating manner.

The lineup of the Train 'A' and Train 'B' air ejectors was verified to be correct (i.e., Train 'A' not in service and Train 'B' in service). In addition, the Control Room Panel C-IL alarm, "Off Gas High Temp", annunciated.

The Main Condenser/Offgas System vapor valves were subsequently verified to be closed. At approximately 1035 hours, the Control Room Panel C-2L alarm, "Condenser Low Vacuum", annunciated with the Main Condenser vacuum at approximately 25.0 inches of mercury. The vacuum corresponded to a Main Condenser hotwell saturation temperature of approximately 134 degrees Fahrenheit.

With the Main Condenser/Offgas System vapor valves closed, the decreasing Main Condenser vacuum could not be improved. At that time, the Main Condenser vacuum was near the automatic RPS scram setpoint (calibrated at 24.7 inches of mercury). Because of the decreasing Main Condenser vacuum, together with the closed Main Condenser/Offgas System vapor valves that indicated the Main Condenser vacuum could not be improved, the Chief Operating Engineer (utility licensed operator) recommended the initiation of a manual RPS scram. The shift NWE (utility licensed operator) directed the (utility licensed) Reactor Control Panel C-905 operator to initiate the manual RPS scram via the RMSS. The manual RPS scram was conservative in that an automatic RPS scram signal (due to a low Main Condenser vacuum trip) was anticipated.

CAUSE

The scram was the result of the deliberate movement of the (keylocked) reactor mode selector switch (RMSS) from the RUN position to the SHUTDOWN position. When the RMSS was moved out of the RUN position, the Average Power Range Monitor (APRM) setdown trip relays (5A-K27 series) became de-energized and with reactor power at approximately 35 percent, resulted in Hi-Hi trip signals from the APRMs. Moving the RMSS to the SHUTDOWN position was planned and is in accordance with procedure 2.1.6, "Reactor Scram".

The primary cause for the decreasing Main Condenser vacuum was an inadequacy in the procedure 2.2.93 (Rev. 15), "Main Condenser Vacuum System", section 7.3 (SJAE operation). The procedure contained steps for preparing the SJAE subsystem for operation, for placing an SJAE subsystem Train ('A' or 'B') into service, and for removing an SJAE subsystem Train ('A' or 'B') from service. However, the procedure did not limit the number of air ejectors that could be in service during a reconfiguring evolution.

Because of the procedural inadequacy, a total of six air ejectors were allowed to be operated simultaneously on two occasions while the SJAE subsystem Trains were being reconfigured. Normally, three air ejectors in one SJAE train would have been in service. However, the three extra air ejectors that were in service on those two occasions introduced additional steam loading to the Intercondenser and Aftercondenser. The steam loading together with the increased temperature of the (hotwell) condensate to the Intercondenser and Aftercondenser, adversely affected the heat transfer capacity of the Intercondenser and Aftercondenser. The decreased capacity caused the Main Condenser vacuum to decrease and caused an increase in the temperature of the gasses and water vapor downstream of the Aftercondenser. The (increased) temperature, sensed by the downstream Offgas System temperature switches TS-3717A and -3717B, resulted in the automatic closing of the four Main Condenser/Offgas System vapor valves (AO-3703, -3710, -3704, -3711).

CORRECTIVE ACTION

Procedure 2.2.93 - Rev. 15 has been revised. Essentially, a new procedural step was added that provides detailed instructions, notes, and cautions for interchanging an air ejector(s) during operation. The procedure now allows only one air ejector to be transferred at a time and therefore limits the total number of air ejectors in service to a maximum of 4 (four). The revised procedure also provides for documenting the air ejector(s) in service prior to the evolution and in service after the evolution and for documenting the steps taken. The revised procedure was approved on July 21, 1989.

While shutdown, the saltwater portions of the Circulating Water System, Main Condenser, and heat exchangers serviced by the Salt Service Water System were cleaned. The cleaning was performed to remove macro-fouling due to marine organisms.

An Engineering Service Request (ESR 89-609) was written to explore the possible modification of the control circuitry for the Main Condenser/Offgas System vapor valves. The vapor valves' control circuitry, although provided with a reset feature, does not include a bypass feature. The control circuitry, including the temperature switches, functions to protect the Main Condenser Gas Removal System from damage if recombination of oxygen and hydrogen should occur in the piping downstream of the Aftercondenser and upstream of the Offgas System Recombiners.

SAFETY CONSEQUENCES

This event posed no threat to the public health and safety.

The scram signal was the expected response to the deliberate movement of the RMSS from the RUN position while at 35 percent reactor power. The Turbine trip and Generator trip were the expected designed responses to the scram signal.

The momentary low RV water level was the expected response to the scram and accompanying shrink in the RV water. The PCIS and RBIS actuations were the expected designed responses to the low RV water level.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) because the manual actuation of the RPS was not a preplanned part of the sequence (procedure 2.2.93) being performed.

SIMILARITY TO PREVIOUS EVENTS

A review was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted since January 1984. The review focused on LERs submitted in accordance with 10 CFR 50.73(a)(2)(iv) that involved a full RPS scram signal or reactor scram due to a procedural problem.

The review identified related events reported in LERs 50-293/84-014-00, 88-002-00, and 88-019-00.

For LER 84-014-00, an unplanned RPS scram signal occurred during a refueling outage. At the time of the event, the Reactor Vessel (RV) was completely defueled and the Scram Discharge Volume (SDV) water level sensors were in the tripped condition for SDV maintenance. The scram signal occurred when the 480 " C Bus B-4 became de-energized while attempting to cross-tie Bus B-4 to Bus B-2. Bus B-4 was providing power to the RPS motor-generator set 'B' and RPS Channel 'B'. The loss of power to RPS Channel 'B', together with the tripped condition of the SDV water level sensors, resulted in a full scram signal. The cause for the event was attributed to a procedural inadequacy (for cross-tying the busses).

For LER 88-002-00, an unplanned RPS scram signal occurred while performing a surveillance test (8.M.2-2.1.1) during an outage. At the time of the event, the RMSS was in the SHUTDOWN position and the control rods were in the inserted position. The scram signal occurred when a RV water level indicator (LI-263-59A) was being returned to service after a calibration of the level indicator. The cause for the scram signal was attributed to procedural inadequacy in that the procedure did not contain sufficient instructions or cautions for isolating, connecting and disconnecting test equipment, and returning the local level indicators (including LI-263-59A) to service.

For LER 88-019-00, an unexpected RPS scram signal occurred during an outage while performing a post modification test of the Anticipated Transient Without Scram (ATWS) Division 2 (two) circuitry. At the time of the event, the RMSS was in the SHUTDOWN position, the control rods were in the inserted position, the Control Rod Drive System (CRDS) pumps were not in service, and the Hydraulic Control Units were vented. The test (TP 87-126) resulted in the expected depressurization of the CRDS scram air header and the draining of water from the CRDS piping into the SDV tanks. When the SDV water level increased to a level corresponding to the trip condition, the subsequent scram signal occurred. The scram signal, although a designed and subsequent response to the test, was not expected by the utility operators in the Control Room because the scram signal was not identified in the test procedure and because the CRDS had been removed from service for maintenance. The cause for the scram signal was attributed to an inadequate review (and development) of the test procedure.

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS CODES

Circuit Breaker, AC 52
Condenser (Main, Intercondenser, Aftercondenser) COND
Ejector (SJAE) EJC
Switch, Temperature (TS-3717 A/B) TS
Valve, Leakoff (AO-3703, -3704, -3710, -3711) LOV
Valve, Isolation (PCS valves) ISV

SYSTEMS

Condenser System SC
Condenser Vacuum (MCGR) System SH
Containment Isolation Control System (PCIS,RBIS) IM
Engineered Safety Features Actuation System

(RPS,PCIS,RBIS) JE
Main Generator System TB
Main Generator Output Power System (345KV) EL
Main Turbine System TA
Plant Protection System (RPS) JC
Reactor Building (SCS) NG
Reactor Recirculation System AD
Reactor Water Cleanup (RWCU) System CE
Standby Gas Treatment (SGTS) System BH

ATTACHMENT 1 TO 8908230283 PAGE 1 OF 1

10 CFR 50.73

BOSTON EDISON

Pilgrim Nuclear Power Station
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Ralph G. Bird
Senior Vice President - Nuclear

August 17, 1989
BECo Ltr. 89-123

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Docket No. 50-293
License No. DPR-35

Dear Sir:

The enclosed Licensee Event Report (LER) 89-023-00, "Decreasing Main Condenser Vacuum Resulting in the Initiation of a Manual Scram Due to Procedure Inadequacy", is submitted in accordance with 10 CFR Part 50.73.

Please do not hesitate to contact me if there are any questions regarding this report.

R. G. Bird

DWE/bal

Enclosure: LER 89-023-00

cc: Mr. William Russell
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U. S. Nuclear Regulatory Commission
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Sr. NRC Resident Inspector - Pilgrim Station

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